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adding those products,  $2^i q$ , which correspond to those quotients of  $p$  that are odd numbers.

E. g.  $51 \times 81$ . 25, 162; 12, 324; 6, 648; 3, 1,296; 1, 2,592.

$$51 \times 81 = 81 + 162 + 1,296 + 2,592 = 4,131.$$

Prove or disprove the truth of the above proposition.

**437. Proposed by C. N. SCHMALL, New York City.**

Given that  $S_1, S_2, S_3, \dots, S_k$  are the sums of  $k$  arithmetical series, each taken to  $n$  terms. The first terms are respectively 1, 2, 3,  $\dots, k$ , and the common differences are 1, 3, 5,  $\dots, (2k-1)$ . Show that

$$S_1 + S_2 + S_3 + \dots + S_k = \frac{nk(nk+1)}{2}.$$

### GEOMETRY.

When this issue was made up, no solutions had been received for numbers 446 and 449.

**466. Proposed by HORACE OLSON, Chicago, Illinois.**

Given the edges of a triangular pyramid, find the radius of the inscribed sphere.

**467. Proposed by E. T. BELL, Seattle, Washington.**

It is well-known that if  $i, j, k, l$  are concyclic points,  $W_i$  the Wallace line (frequently, and erroneously, called the Simson line), of  $i$  with respect to the triangle  $jk l$ , then  $W_i, W_j, W_k, W_l$  are concurrent, say in the point  $\{i, j, k, l\}$ . If 1, 2, 3,  $\dots$  denote concyclic points, prove that:

(i)  $\{1, 2, 3, 4\}, \{1, 2, 3, 5\}, \{1, 2, 4, 5\}, \{1, 3, 4, 5\}, \{2, 3, 4, 5\}$  are concyclic; say on the circle  $[1, 2, 3, 4, 5]$ ;

(ii) Starting with 1, 2, 3, 4, 5, 6, omitting each point in turn, by (i), six circles, are found; these are concurrent, say in the point  $\{1, 2, 3, 4, 5, 6\}$ ;

(iii) Starting with 1, 2, 3, 4, 5, 6, 7, seven points of the kind in (ii) are found; these lie on a circle.

(iv) Continuing thus indefinitely, there is, in each case, finally a unique point or circle according as the number of initial points is even or odd. Also, at any stage, the point of concurrence or the circle bears a simple relation to the initial points: what is it?

[Note.—This problem is obviously connected with the theorems of Clifford (*Mathematical Papers*, pp. 38 and 410), but it is interesting to note that it may be completely solved by the methods of Euclid, Books I to III (but at considerable length), and hence is well within the range of high school students. But a very simple proof may be given by the methods of strictly elementary analytical geometry.]

**468. Proposed by ELMER SCHUYLER, Brooklyn, New York.**

Given two circles and a straight line, to draw a circle tangent to the line and coaxial with the two given circles.

**469. Proposed by J. ALEXANDER CLARKE, West Philadelphia High School.**

If in an isosceles triangle, a circle is described on one side as diameter, and a line is drawn through the mid-point of the side parallel to the base, the circle and the parallel will intercept on the trisector of the angle at the vertex a segment equal to the radius of the circle. Show how this can be used to trisect any angle.

### CALCULUS.

When this issue was made up, no solutions had been received for numbers 336, 338–340, 342, 348, 353, 360, and 363.

**387. Proposed by C. N. SCHMALL, New York City.**

Show that the volume bounded by the cone  $x^2 + y^2 = (a-z)^2$  and the planes  $x=0, x=z$ , is  $\frac{3}{8}a^3$ .

**388. Proposed by PAUL CAPRON, U. S. Naval Academy.**

If  $f(x, y) = 0$  represents (in rectangular coordinates) a curve having a simple tangency to the axis of  $x$  at the origin, the value of  $x^2/2y$ , derived from  $f(x, y) = 0$ , and evaluated for  $x=0, y=0$ , will be the radius of curvature at the origin; or if the curve is similarly tangent to the  $y$ -axis at the origin,  $y^2/2x$ , evaluated for  $x=0, y=0$ , is the radius of curvature at the origin.